How to Collect Usable Data; Data Analysis Practices

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Outline

Part 1: Setting up your monitoring program

- Monitoring purpose
- Choosing monitoring sites
- Monitoring schedule
- What parameters

Short break

Outline

Part 2: Analyzing your data

- Basic statistics
- Trends
- Ecoregion comparisons
- Ways to graph your data
- Putting it all together – real world examples
- Worksheet

Questions

Assumptions

- Parameter names and definitions
- Basic limnology
- Basic aquatic ecology
- Refer to cheat sheet

Monitoring Purpose

- Condition and trends
- Implementation project efficacy
- Point source impact
- Event-based monitoring

Data Sets

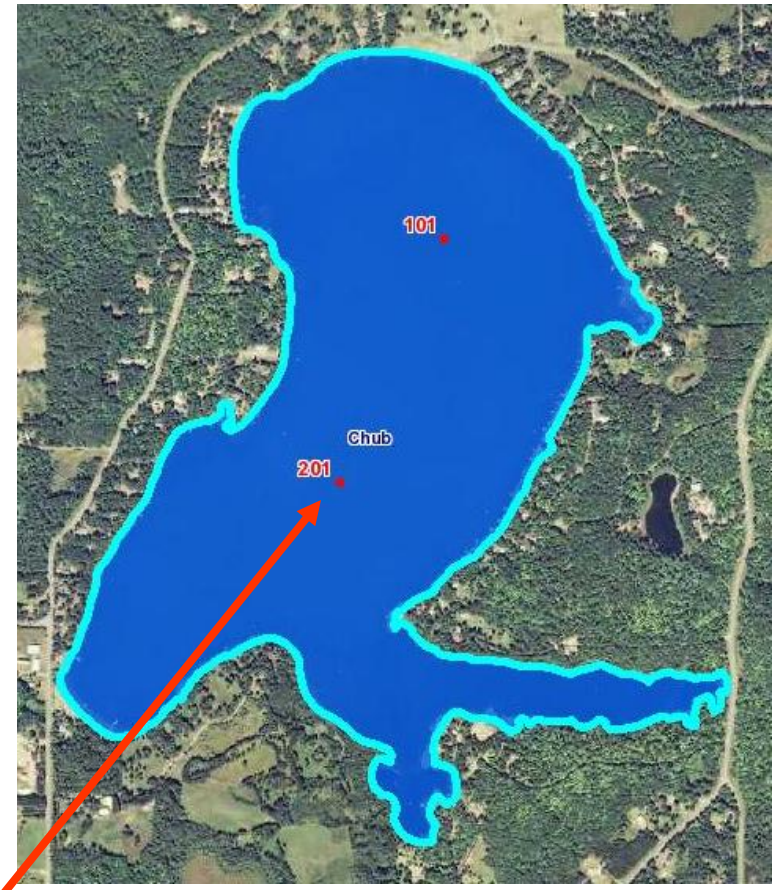
- **Make sure you collect data that you'll use!**
- Too much data is overwhelming to analyze
- Data loggers can be useful or overwhelming depending on how you receive and use the data
- Continuous baseline data can be useful for future projects

Lake Condition and Trends - Basic

- Site: One primary site per basin
- Schedule: At least 4-5 times per summer, evenly spaced, May – Sept.
- Parameters: Transparency, TP, CHLA
  - Transparency weekly if possible
  - Volunteers can be excellent partners and a way to save money

Site Selection

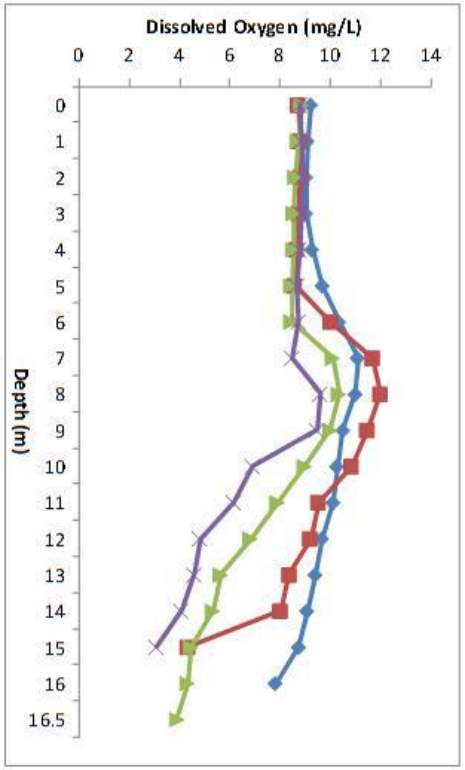
- The deepest spot on the lake that best represents the lake basin
- Most lakes have monitoring sites established by the MPCA



Monitoring Site = #201

Lake Condition and Trends - Advanced

- If data assessment shows internal loading could be a problem:
  - Dissolved oxygen profiles
  - Hypolimnion TP and OP samples



Streams

- Concentration data can give an indication of water quality
- Need flow data as well to calculate loading

Stream Loading

- Creek vs. River

high TP, low flow, intermittent

low TP, high flow, year-round

Stream Loading

- River network

Implementation Project Efficacy

- Streams or ditches (lake more difficult)
- Site: **before & after**, upstream & downstream
- Schedule: baseline and events, ice-free season
- Parameters: TP, TSS (basic)
  - Look at land practices upstream (N+N, OP)

Implementation Project Efficacy

Degraded Riparian Zone | Restored Riparian Zone | Healthy Riparian Zone

Point Source Impact

- Feed lot, discharge pipe, drain tile
- Site: upstream & downstream
- Schedule: baseline and events, ice-free season
- Parameters: TP, OP, N+N (basic)
  - Macroinvertebrates?

Point Source Impact

Event-based Monitoring

- Storm (set precip criteria, >1 inch)
- Site: stream
- Schedule: baseline and events, ice-free season
- Parameters: TP, TSS (basic)
  - Look at land practices upstream (N+N, OP)

Event-based Monitoring

- Shows worst case scenario for runoff
- Need both baseline and events for comparison
- Timing is crucial
  - By hand
  - By autosampler
  - Volunteer?
  - Intern?

Questions?

Break 5 minutes

Outline

Part 2: Analyzing your data

- Basic statistics
- Trends
- Ecoregion comparisons
- Ways to graph your data
- Putting it all together
- Worksheet

Basic Statistics

- Mean, Min, Max

Site	Mean Total Phosphorus (ug/L)	Min Total Phosphorus (ug/L)	Max Total Phosphorus (ug/L)
Pelican 201	**11.6**	7	16
Pelican 206	**12.4**	5	19
Pelican 205	**13.2**	6	25

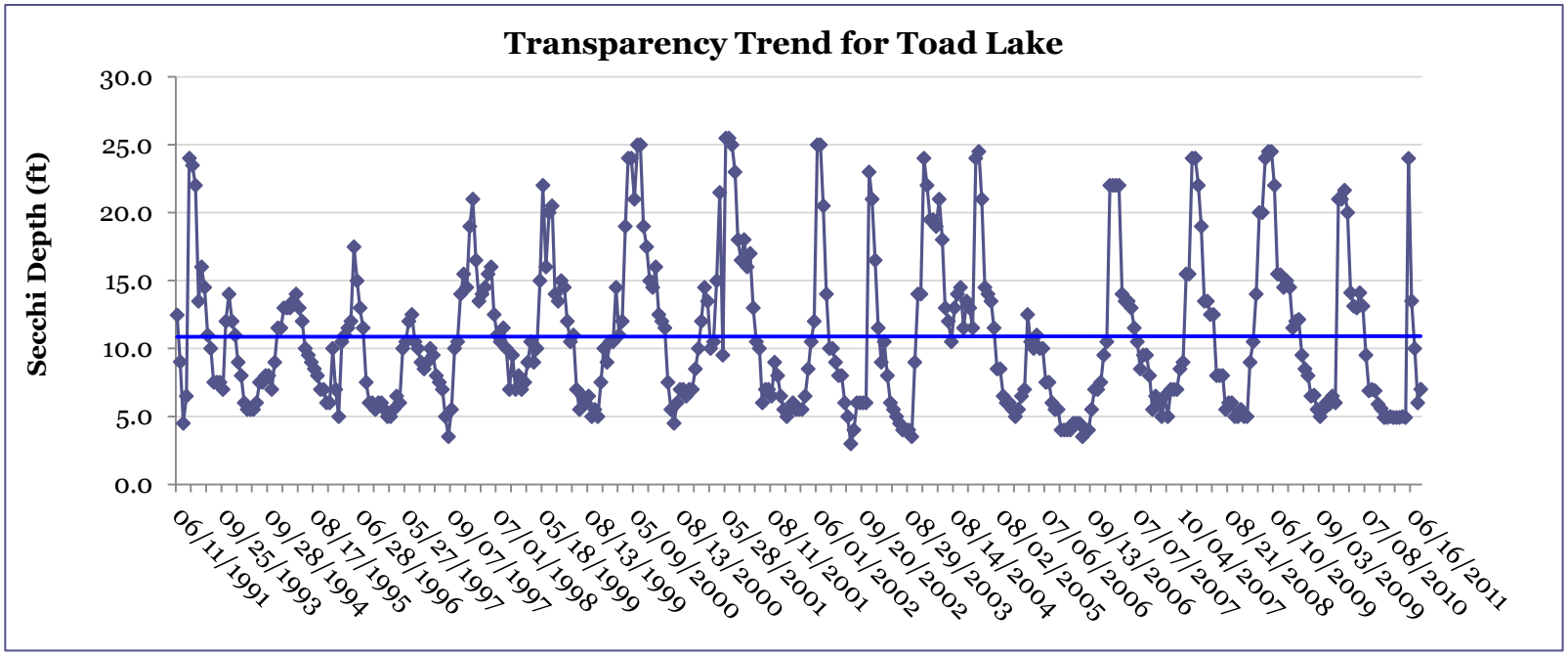
Basic Statistics

- Mean, Min, Max

Site	Min TP (ug/L)	Mean TP (ug/L)	Max TP (ug/L)
Upstream	16	31	40
Downstream	24	36	**82**

Trends

- Is water quality improving, declining or staying the same?



Trends

- Need 8-10 years of consistent data
  - One site only – never combine sites
  - Over 4 data points each year
  - Consistent data points each year
  - Consistent seasonal spread each year
  - Don’t skip years

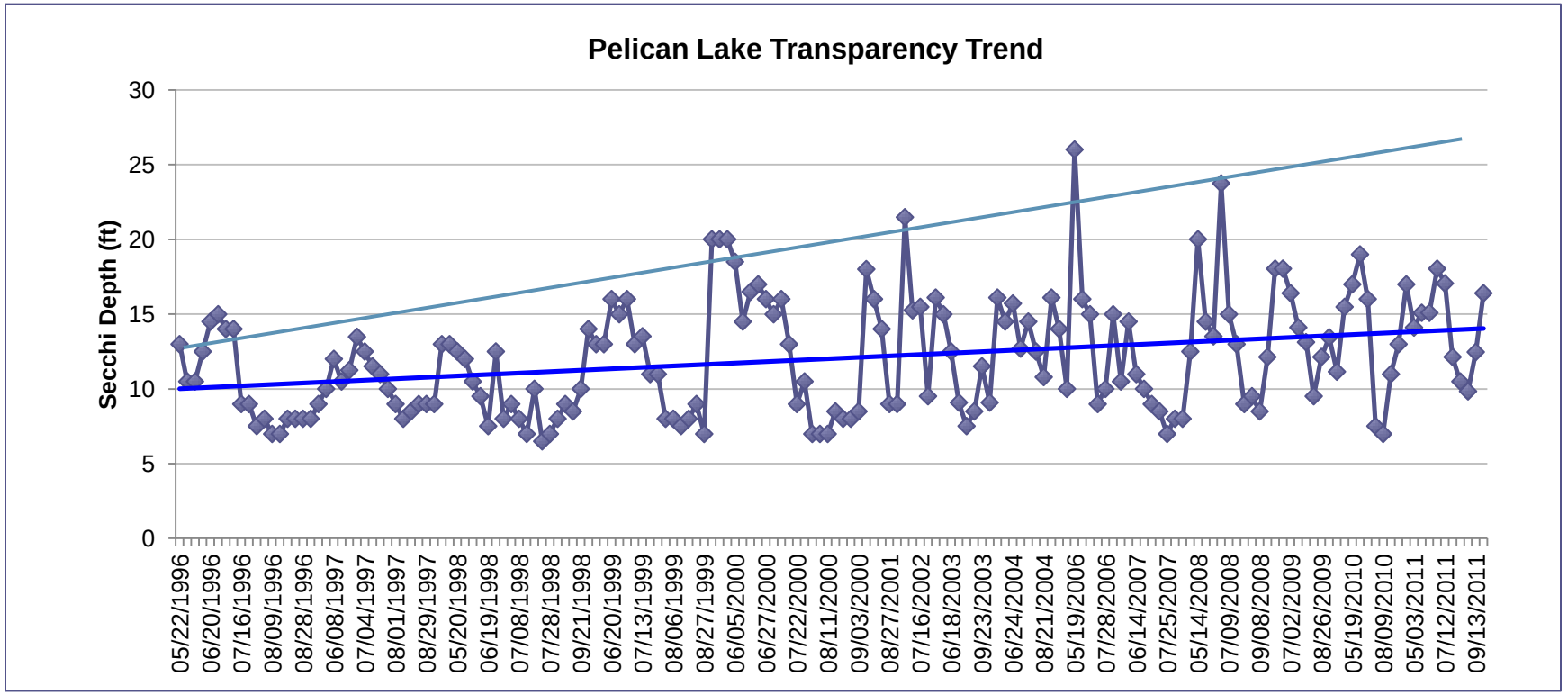
Trends

- Annual Means
- Annual Maxima
- I usually look at both

- Mann Kendall Statistic
  - Want probability of >90%
  - Stats package
  - Excel worksheet

Trends

- Mean and Maximum



Ecoregions

- Lakes and streams in the different parts of the state have different physical and chemical properties
- Ecoregions are a way to group similar conditions affecting water quality
- An ecoregion is a large expanse of land containing a geographically distinct collection of plants, animals, natural communities and environmental conditions

Ecoregions

- Ranges based on 25th-75th quartile of representative lakes and streams in the region
- Find ranges on MPCA website
- Search for “Ecoregions”
- Works for typical lakes and streams, not shallow lakes or ditches

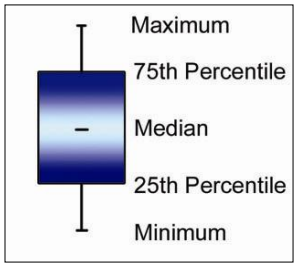
Ecoregion Comparisons

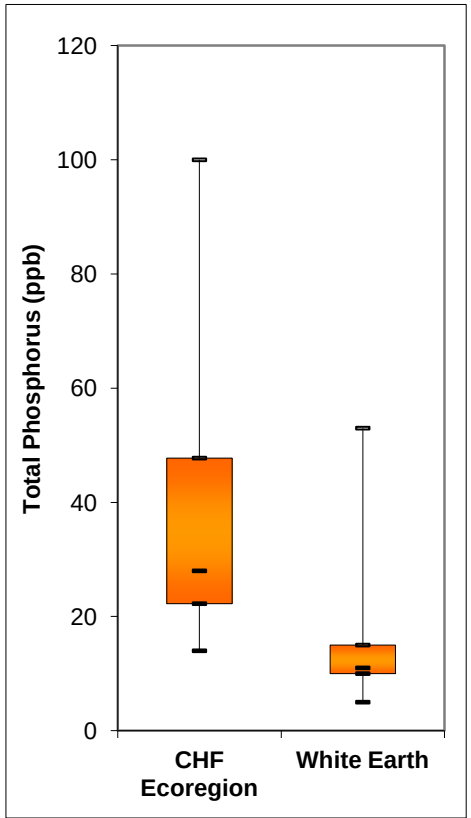
- Table

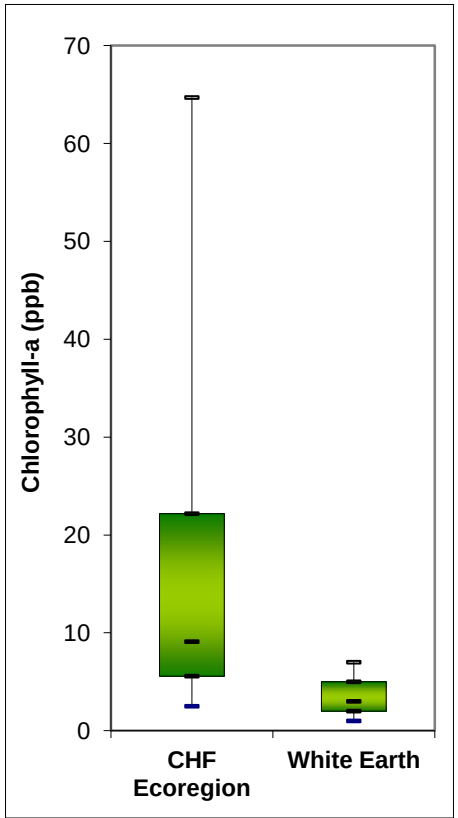
Site Description	N+N (mg/L)	TKN (mg/L)	CL (mg/L)	E.Coli (MPN/100mL)	TP (ug/L)	TSS (mg/L)
Stream	0.03	0.52	3	14	39	1.5
NLF Ecoregion range	0.04-0.26	<0.6 – 1.2	4-10	NA	60-150	4.8-16
Comparison	Under	Under	Under	NA	Under	Under

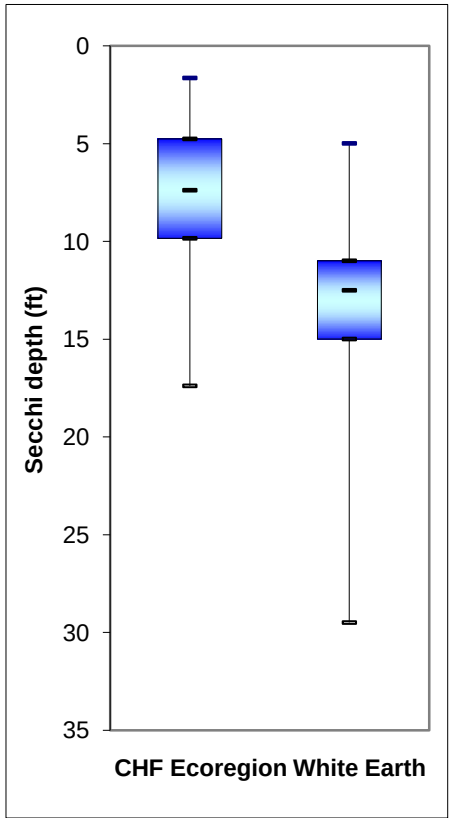
Ecoregion Comparisons

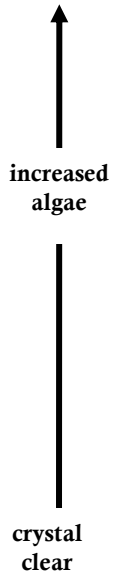
- Box and Whisker Graph





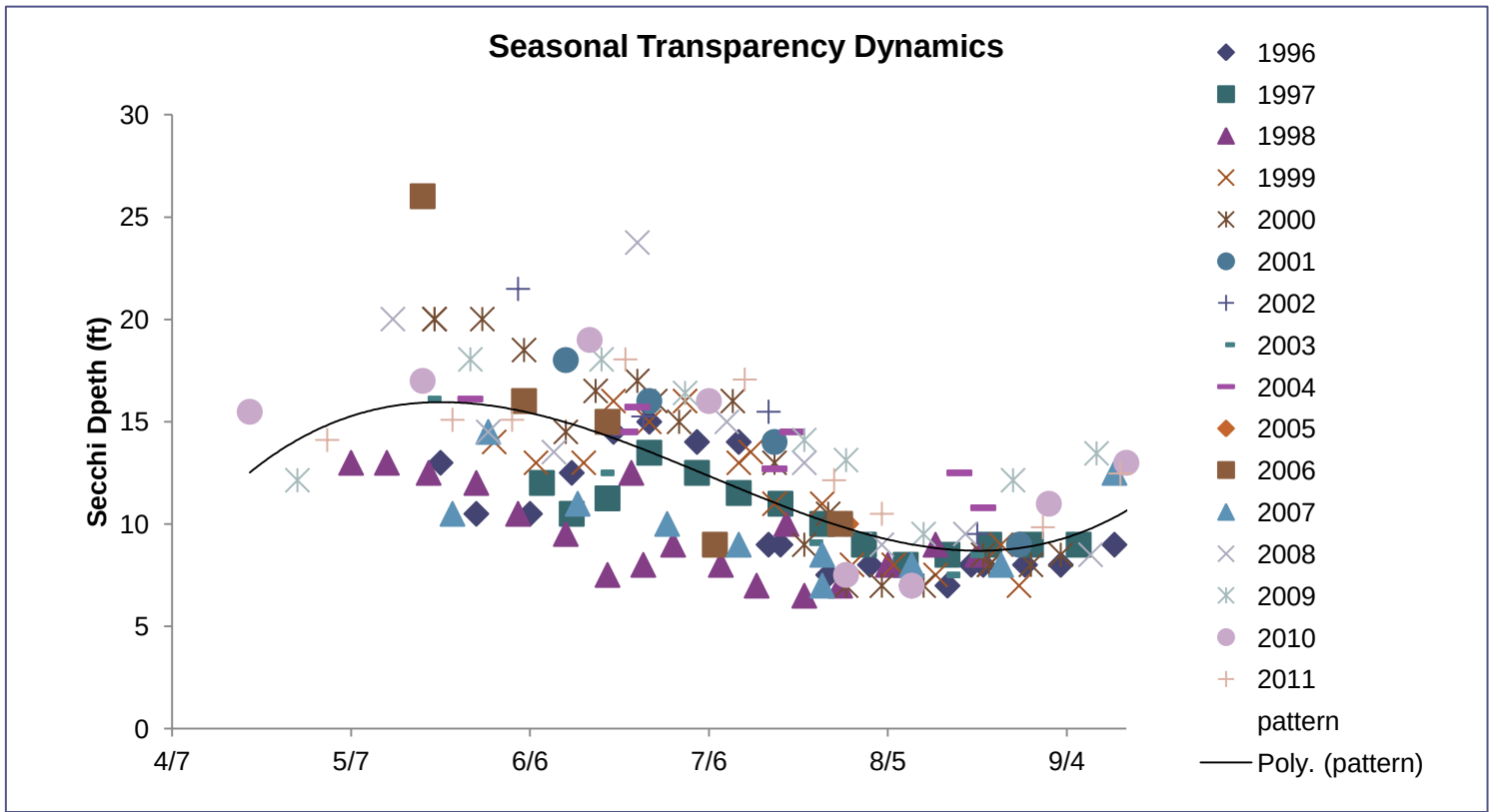






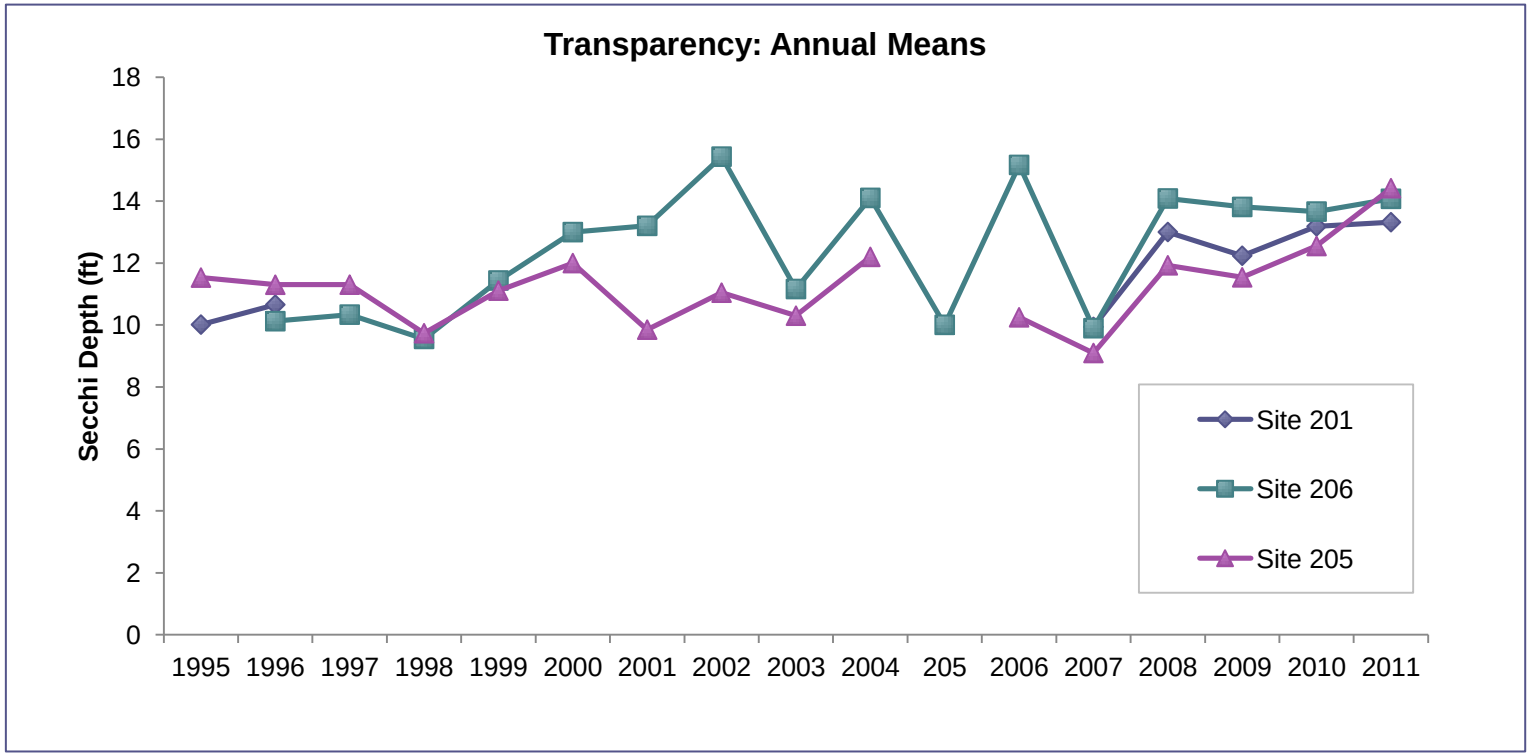
Graphing Data - Lakes

- Seasonal patterns



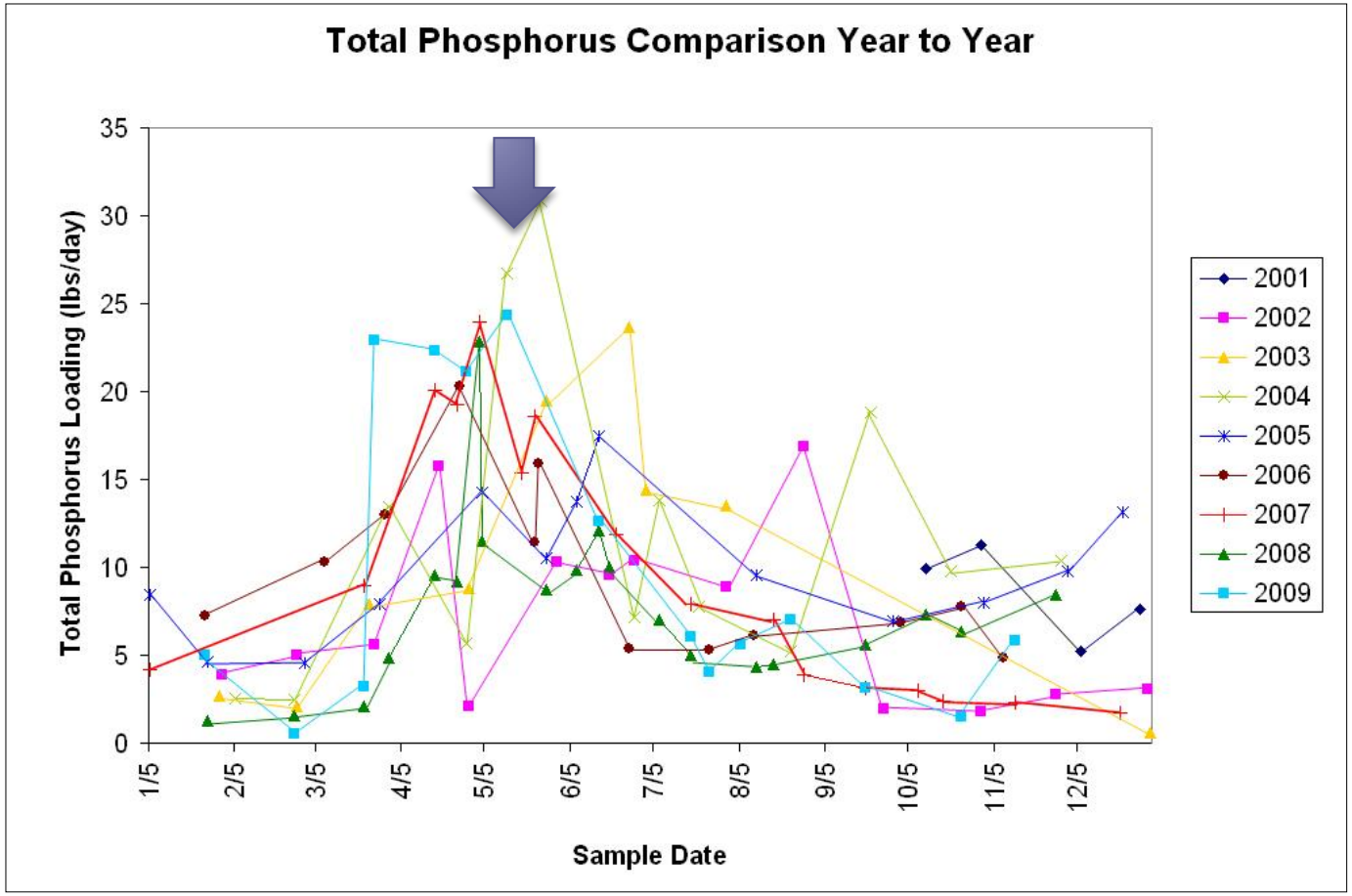
Graphing Data - Lakes

- Comparing sites



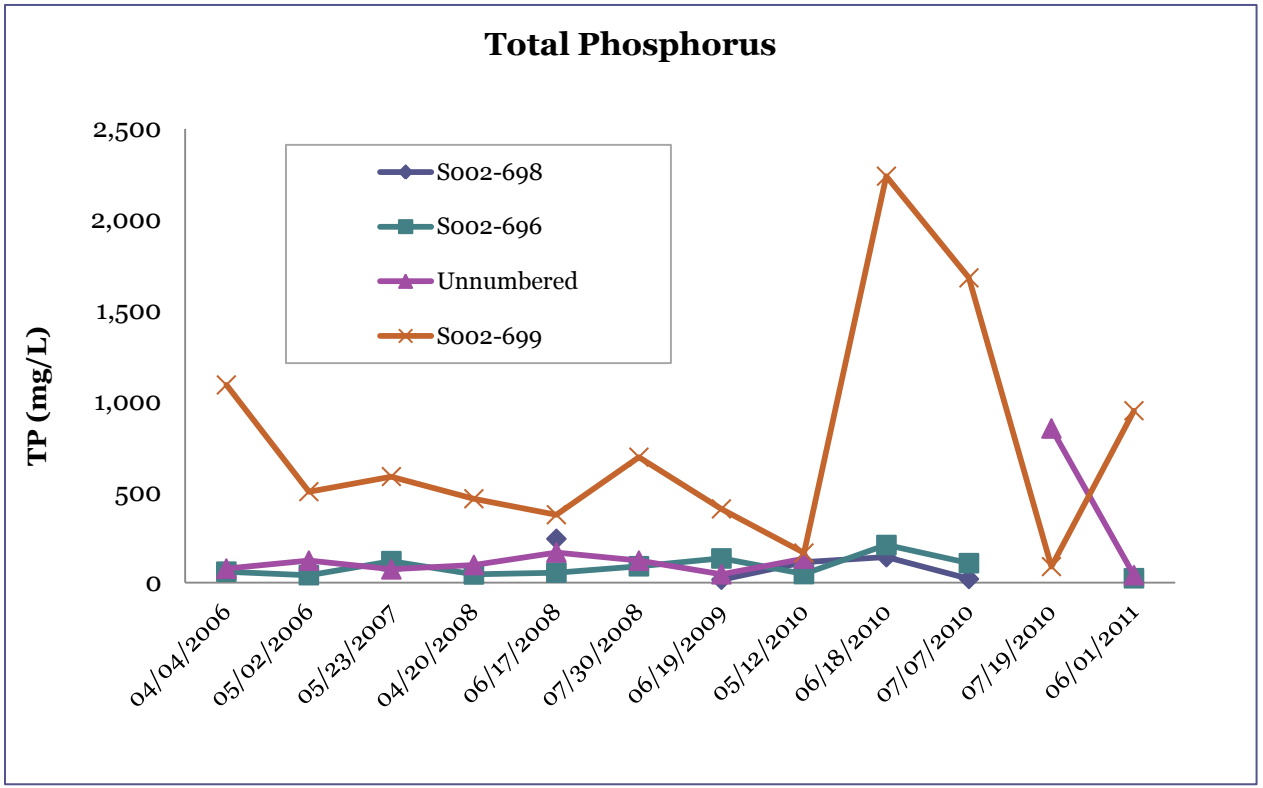
Graphing Data - Streams

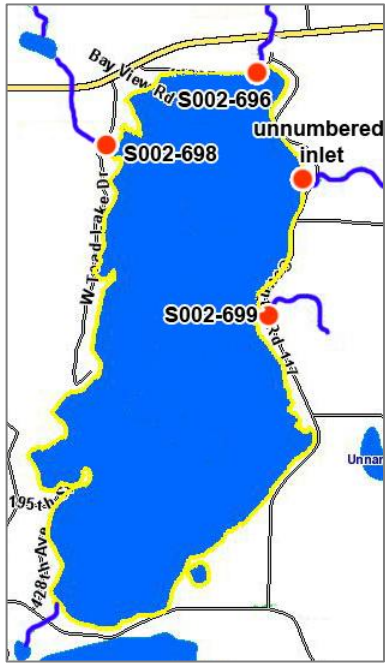
- Seasonal patterns



Graphing Data - Streams

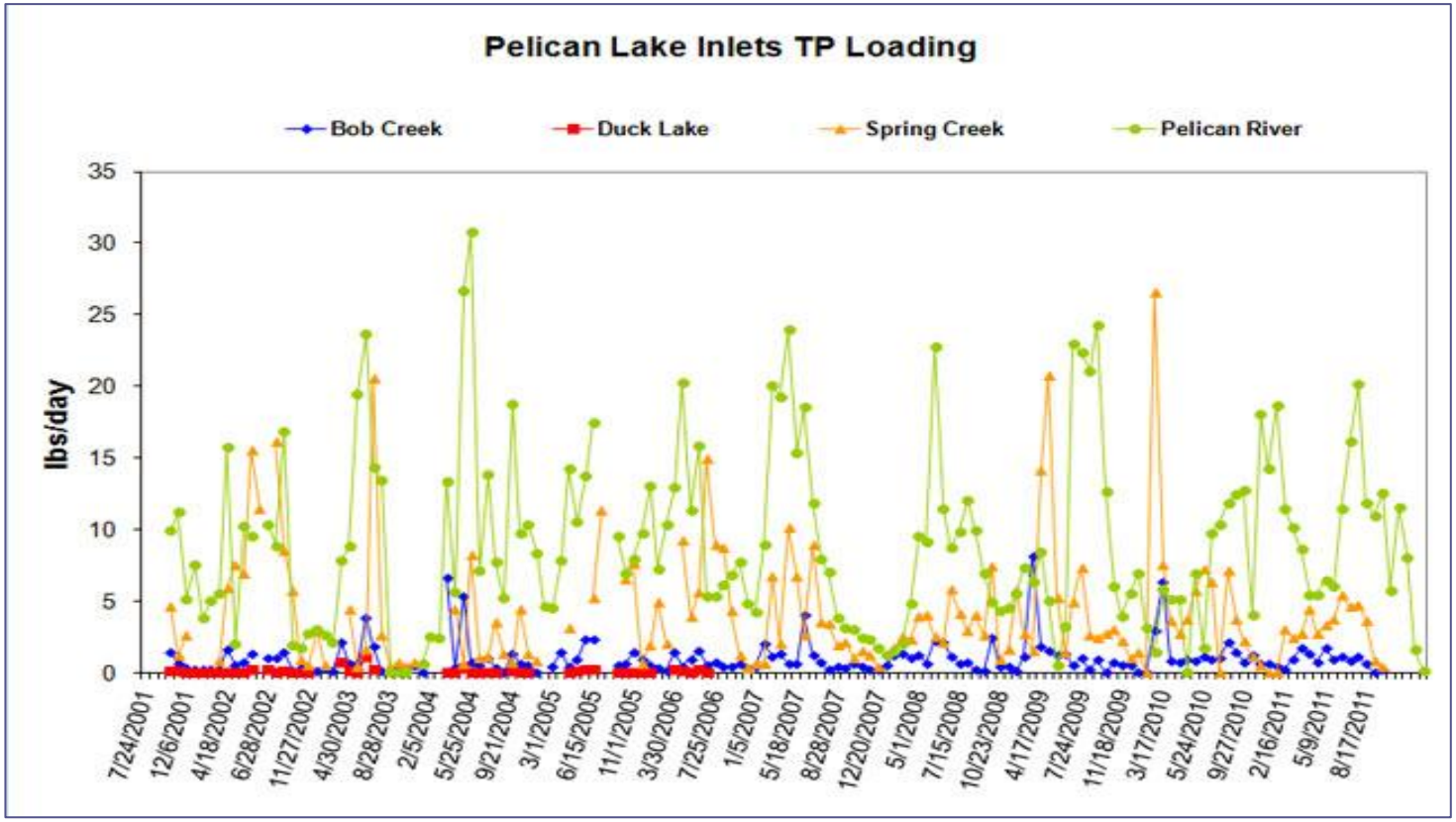
- Comparing sites





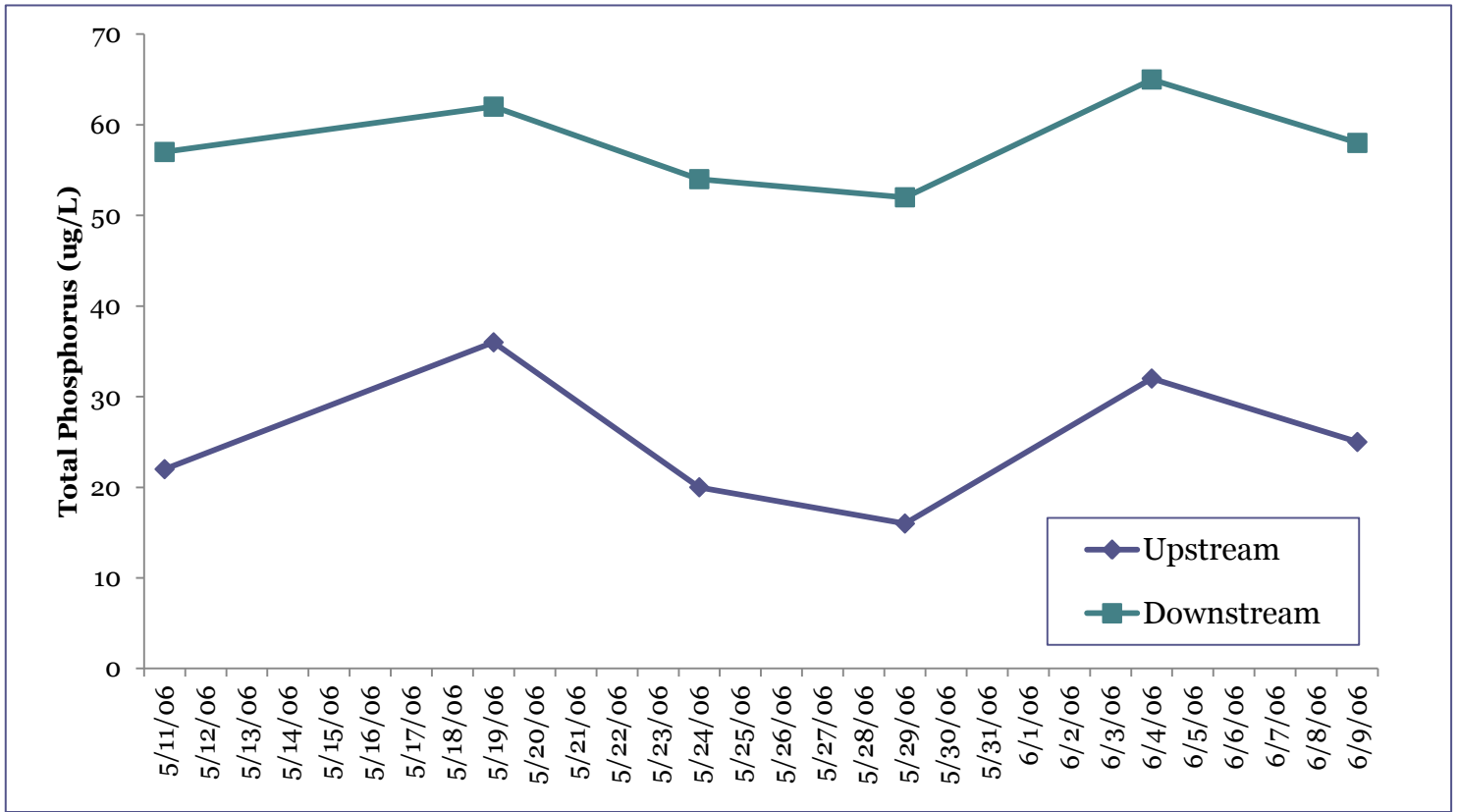
Graphing Data - Streams

- Comparing sites

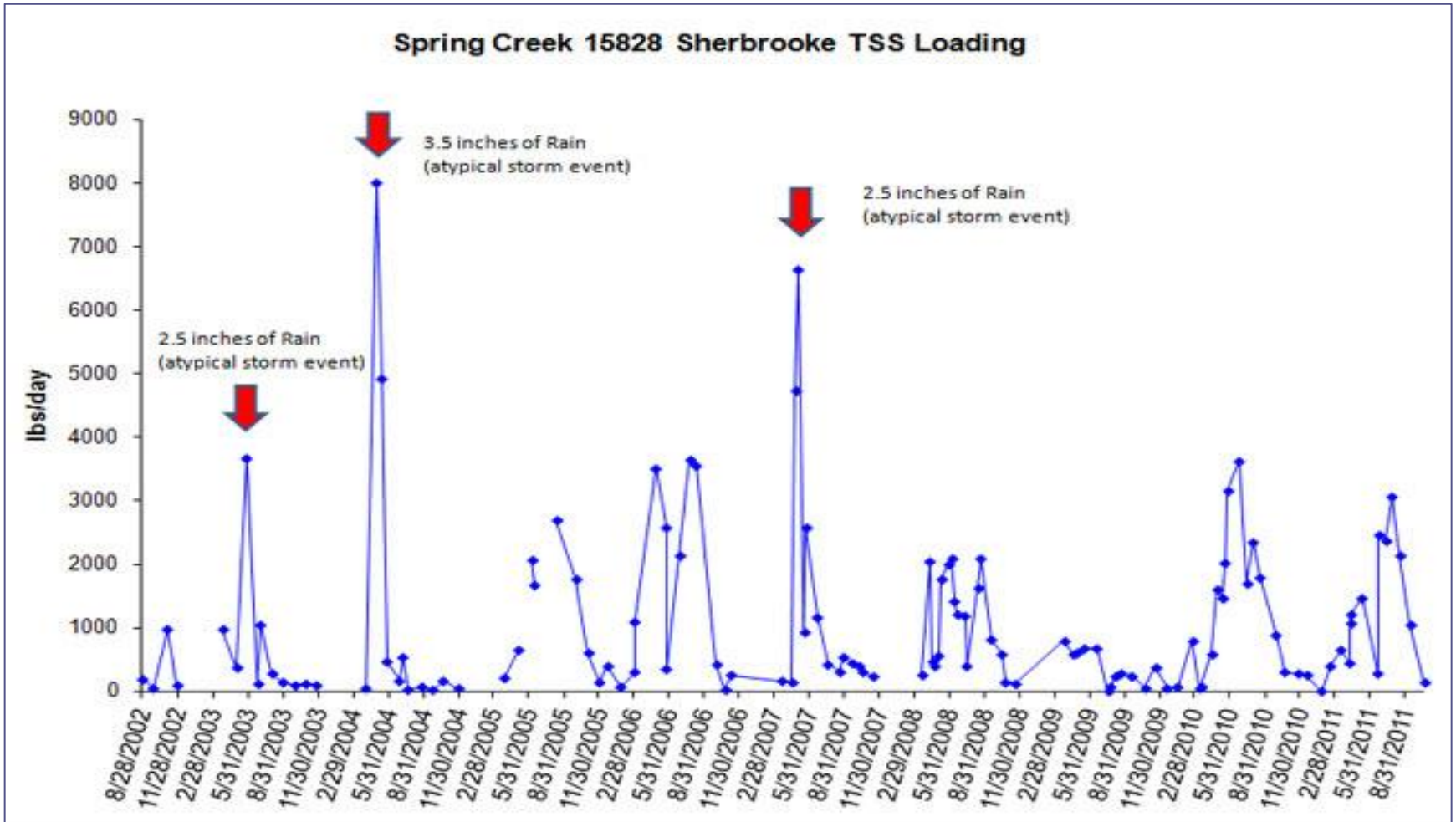


Upstream/Downstream Comparisons

- Graph together



Event-based


Spring Creek 15828 Sherbrooke TSS Loading
lbs/day
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
3.5 inches of Rain
(atypical storm event)
2.5 inches of Rain
(atypical storm event)
2.5 inches of Rain
(atypical storm event)
8/28/2002
11/28/2002
2/28/2003
5/31/2003
8/31/2003
11/30/2003
2/29/2004
5/31/2004
8/31/2004
11/30/2004
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11/30/2008
2/28/2009
5/31/2009
8/31/2009
11/30/2009
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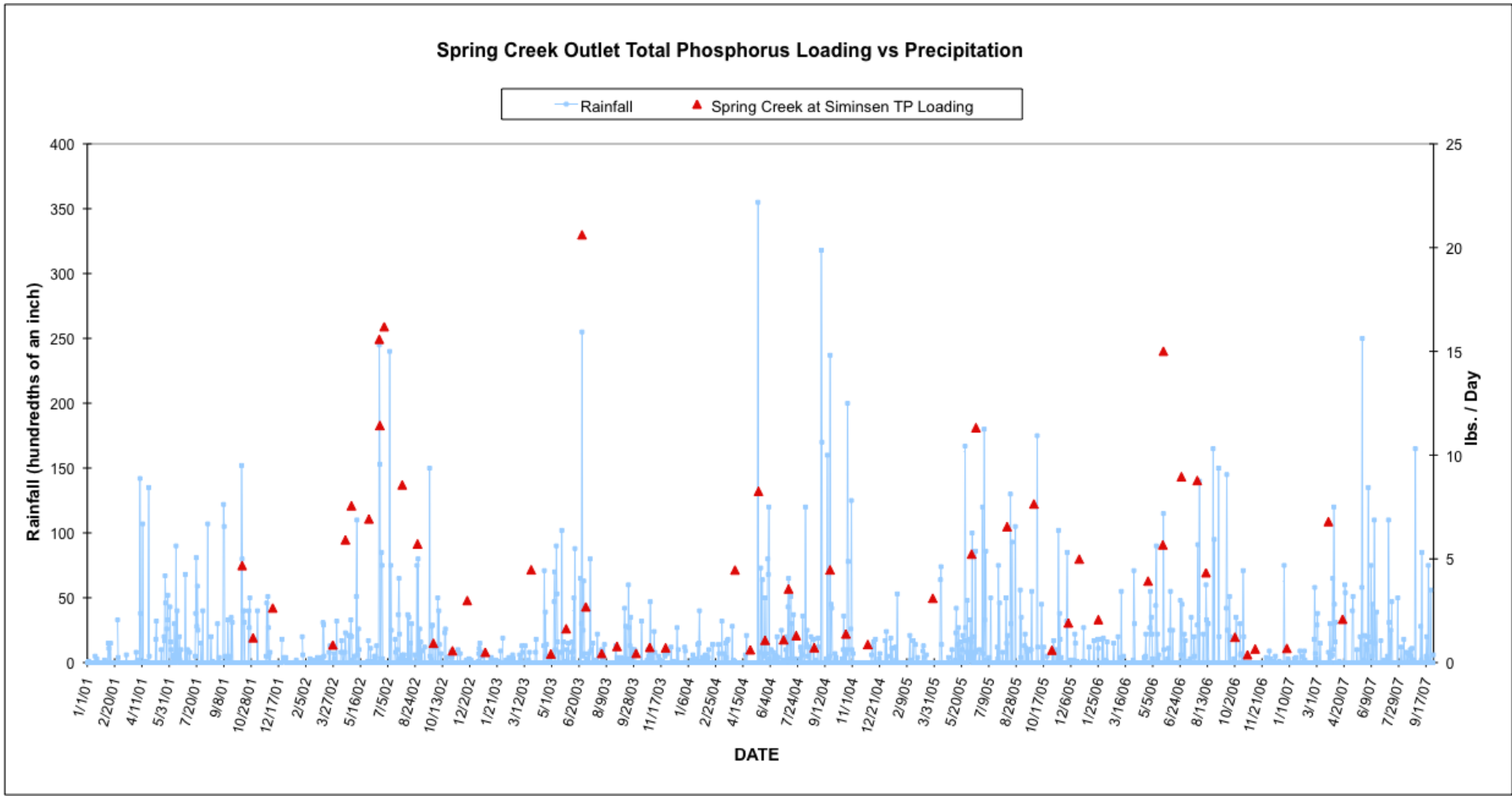
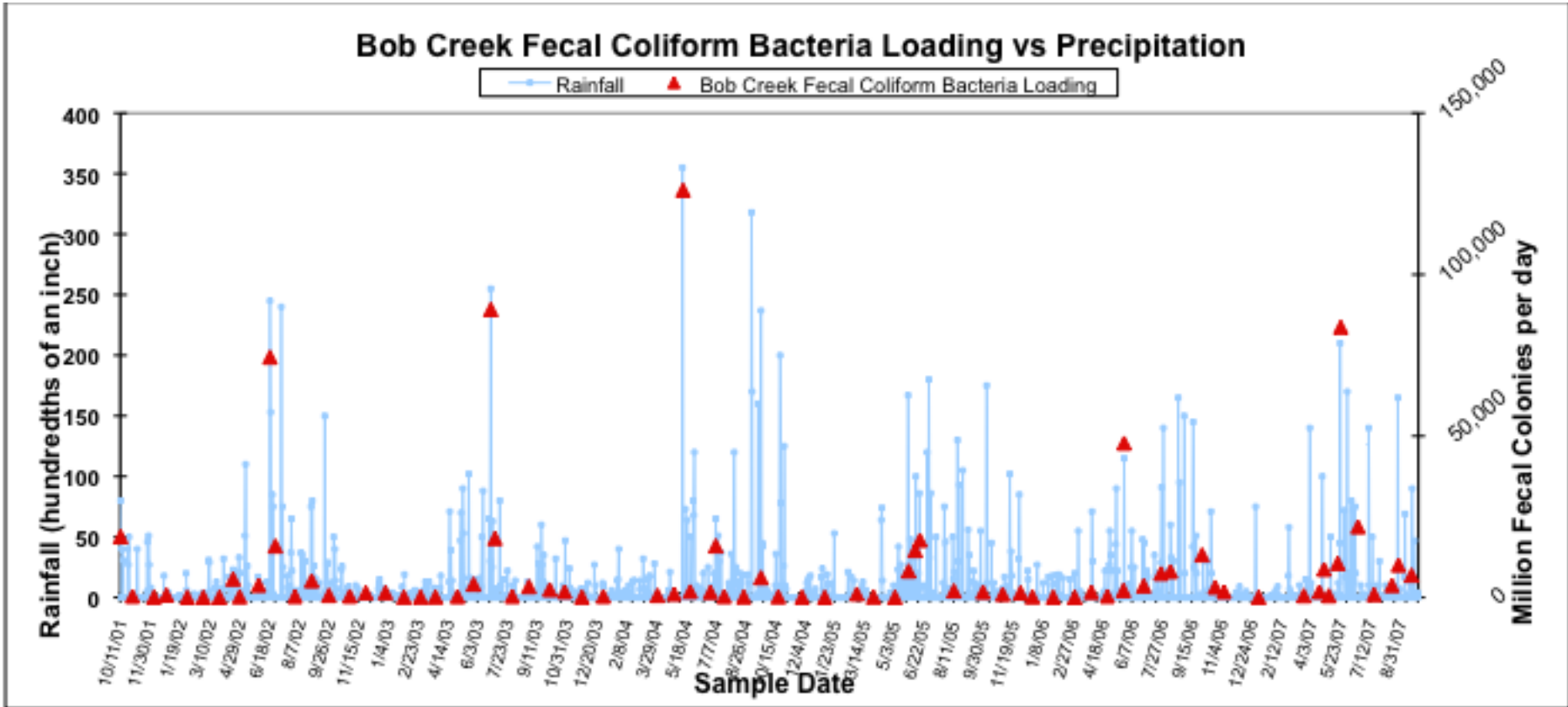
2/28/2011
5/31/2011
8/31/2011

Event-based


Spring Creek Outlet Total Phosphorus Loading vs Precipitation
Rainfall
Spring Creek at Siminsen TP Loading
Rainfall (hundredths of an inch)
lbs. / Day
DATE
400
350
300
250
200
150
100
50
0
25
20
15
10
5
0
1/1/01
2/20/01
4/11/01
5/31/01
7/20/01
9/8/01
10/28/01
12/17/01
2/5/02
3/27/02
5/16/02
7/5/02
8/24/02
10/13/02
12/2/02
1/21/03
3/12/03
5/1/03
6/20/03
8/9/03
9/28/03
11/17/03
1/6/04
2/25/04
4/15/04
6/4/04
7/24/04
9/12/04
11/1/04
12/21/04
2/9/05
3/31/05
5/20/05
7/9/05
8/28/05
10/17/05
12/6/05
1/25/06
3/16/06
5/5/06
6/24/06
8/13/06
10/2/06
11/21/06
1/10/07
3/1/07
4/20/07
6/9/07
7/29/07
9/17/07

Event-based and Impact

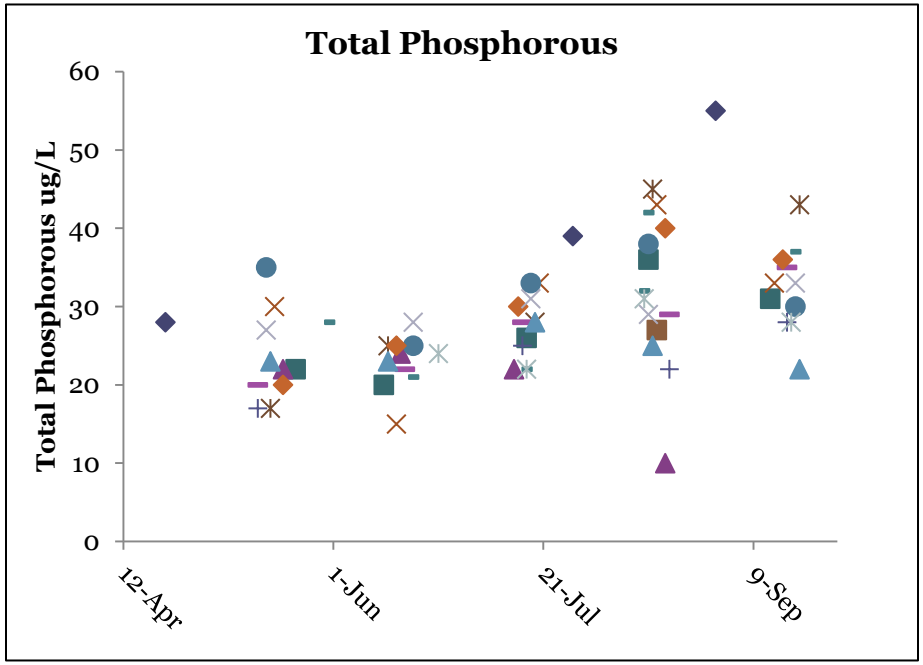
- Downstream of a feed lot

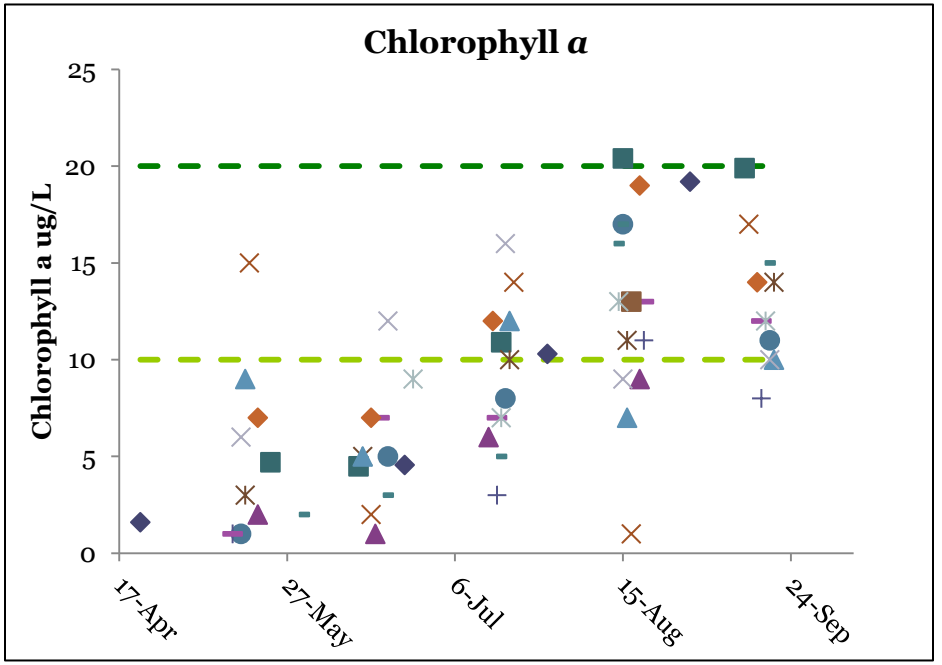


Putting it all together - Examples

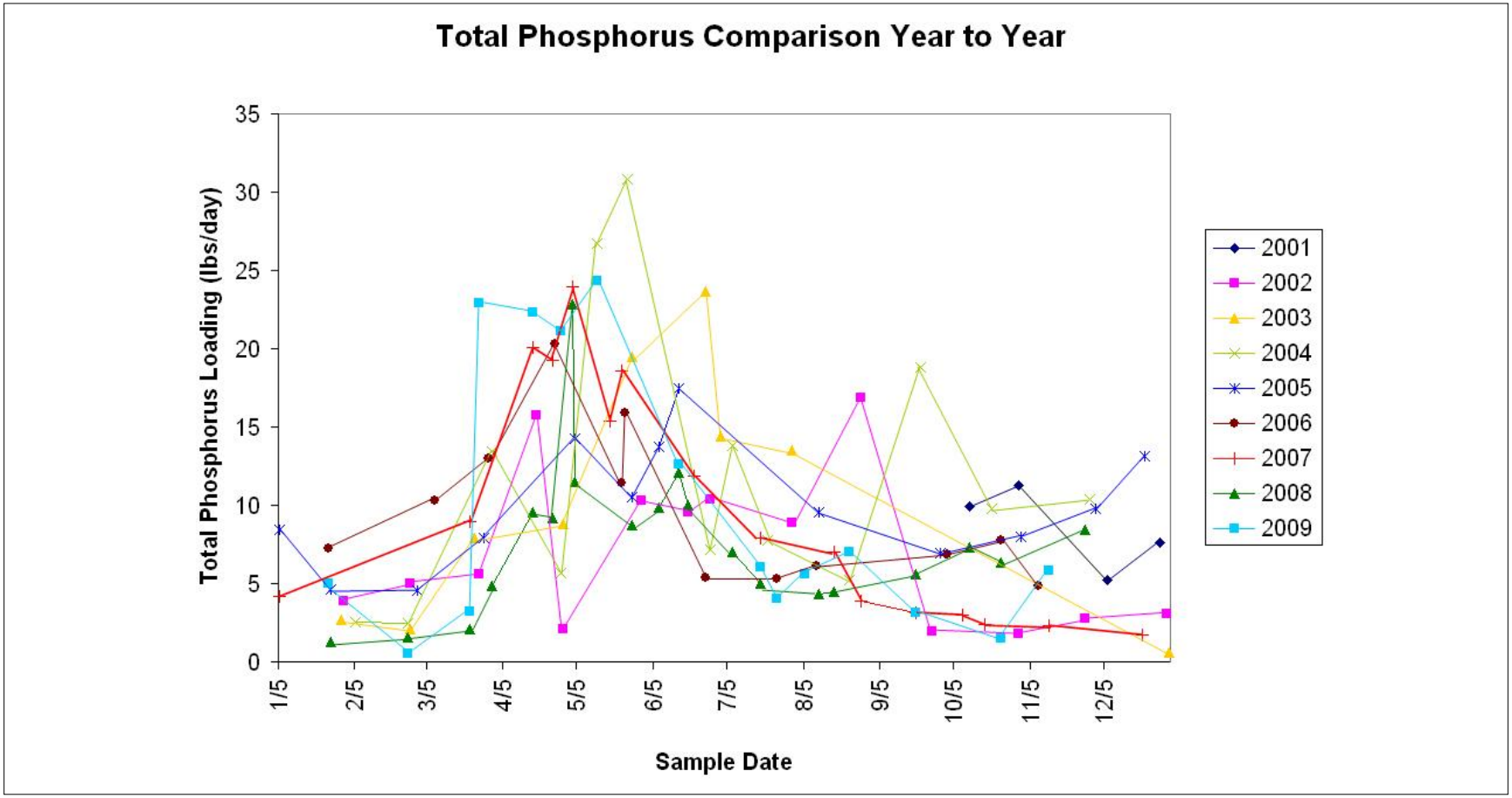
Lake Condition and Trends - Advanced

- If data assessment shows internal loading could be a problem:



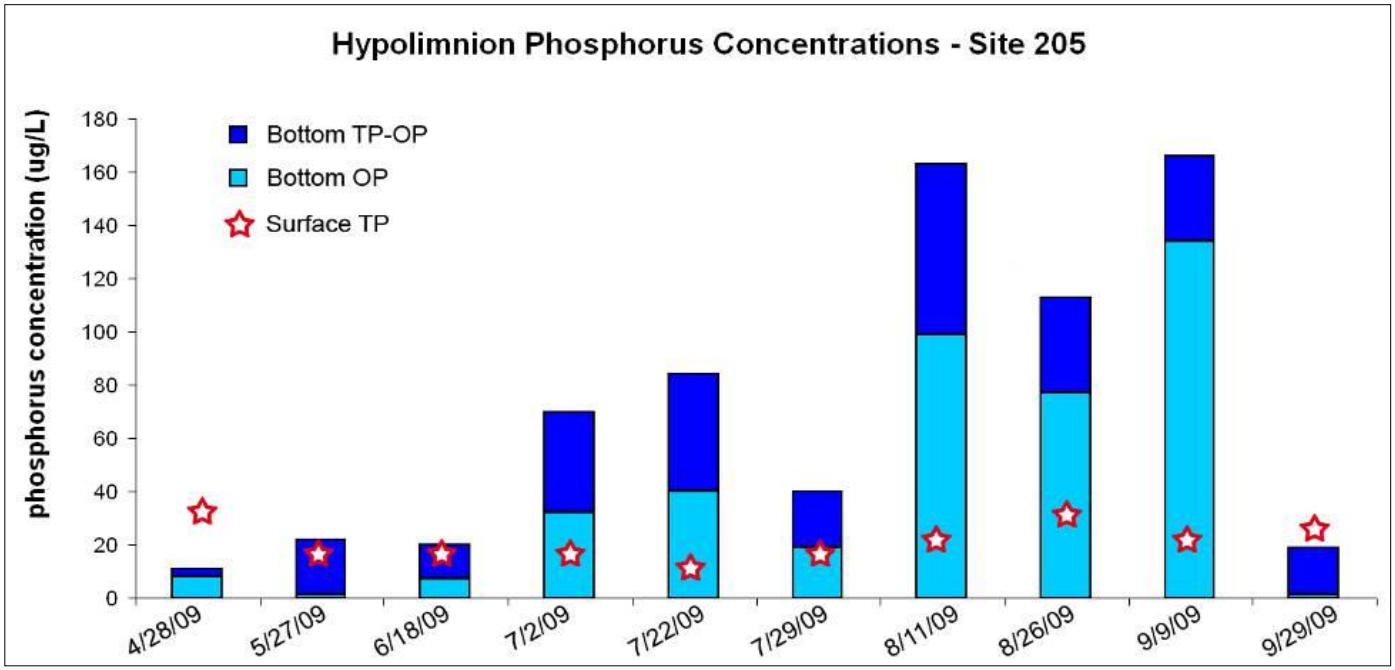


Lake Phosphorus Inlet Pattern



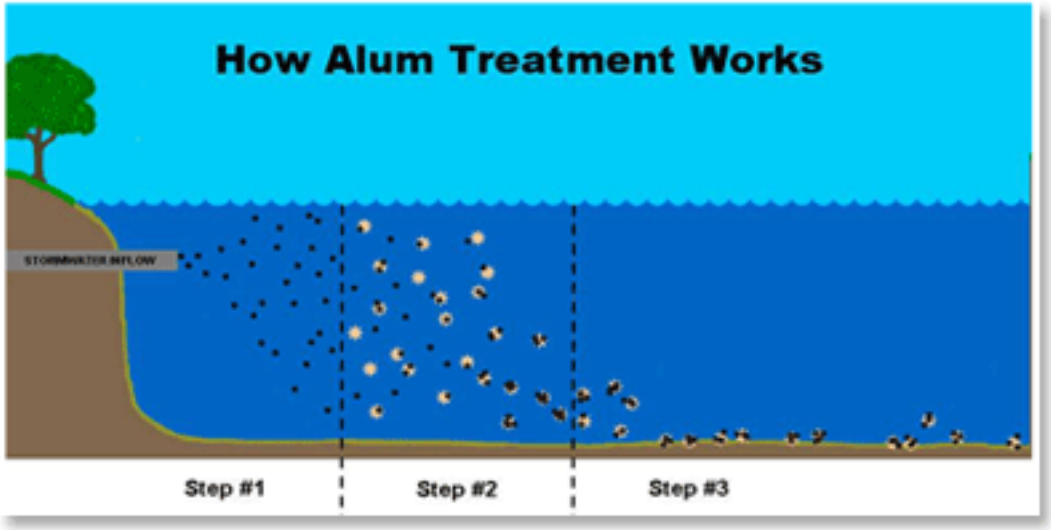
Internal Loading?

- Did 2 years of dissolved oxygen and hypolimnion monitoring



Internal Loading

- Could do before/after study with alum treatment
- Determine efficacy of treatment



Impact, and Implementation Efficacy

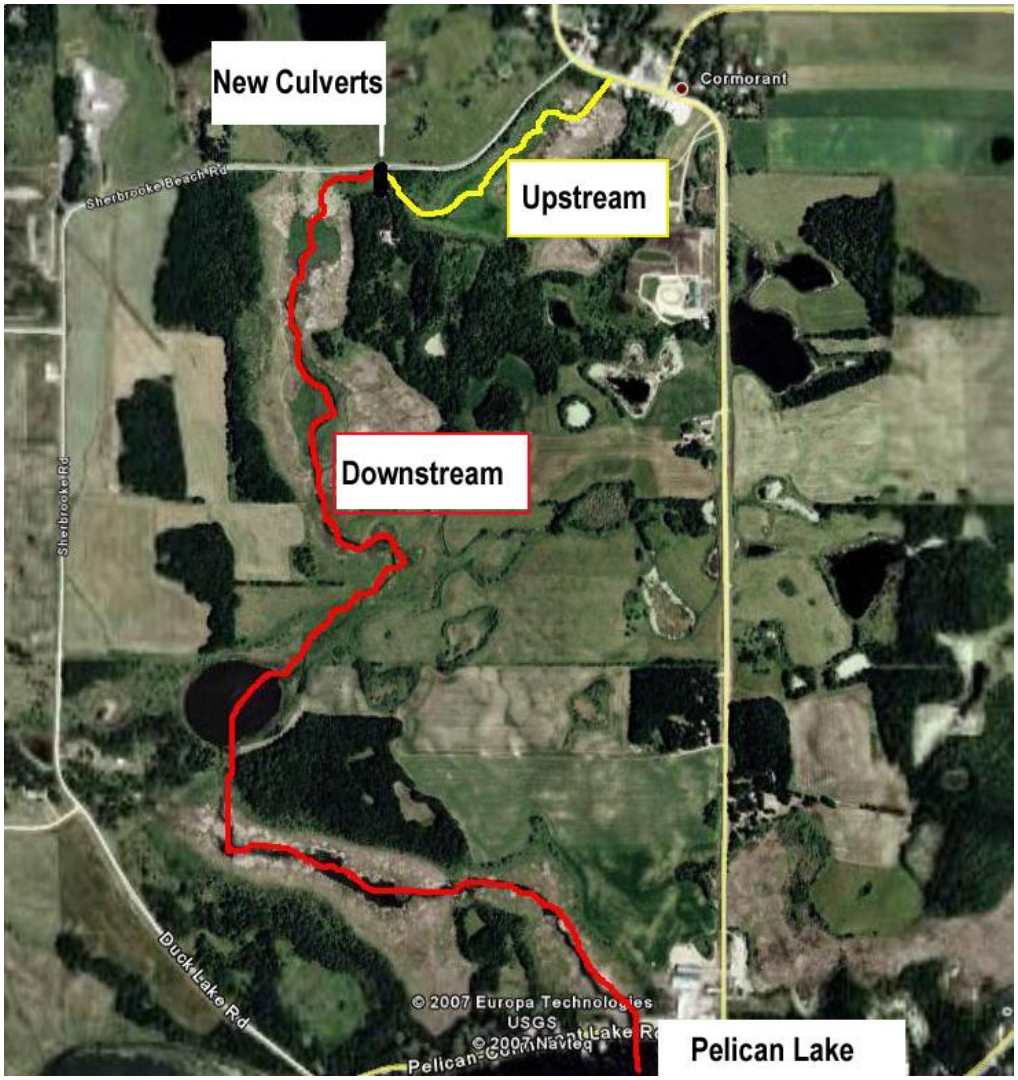
- Culvert installation
- Not stabilized after construction
- Noticeable erosion impact

Impact, and Implementation Efficacy

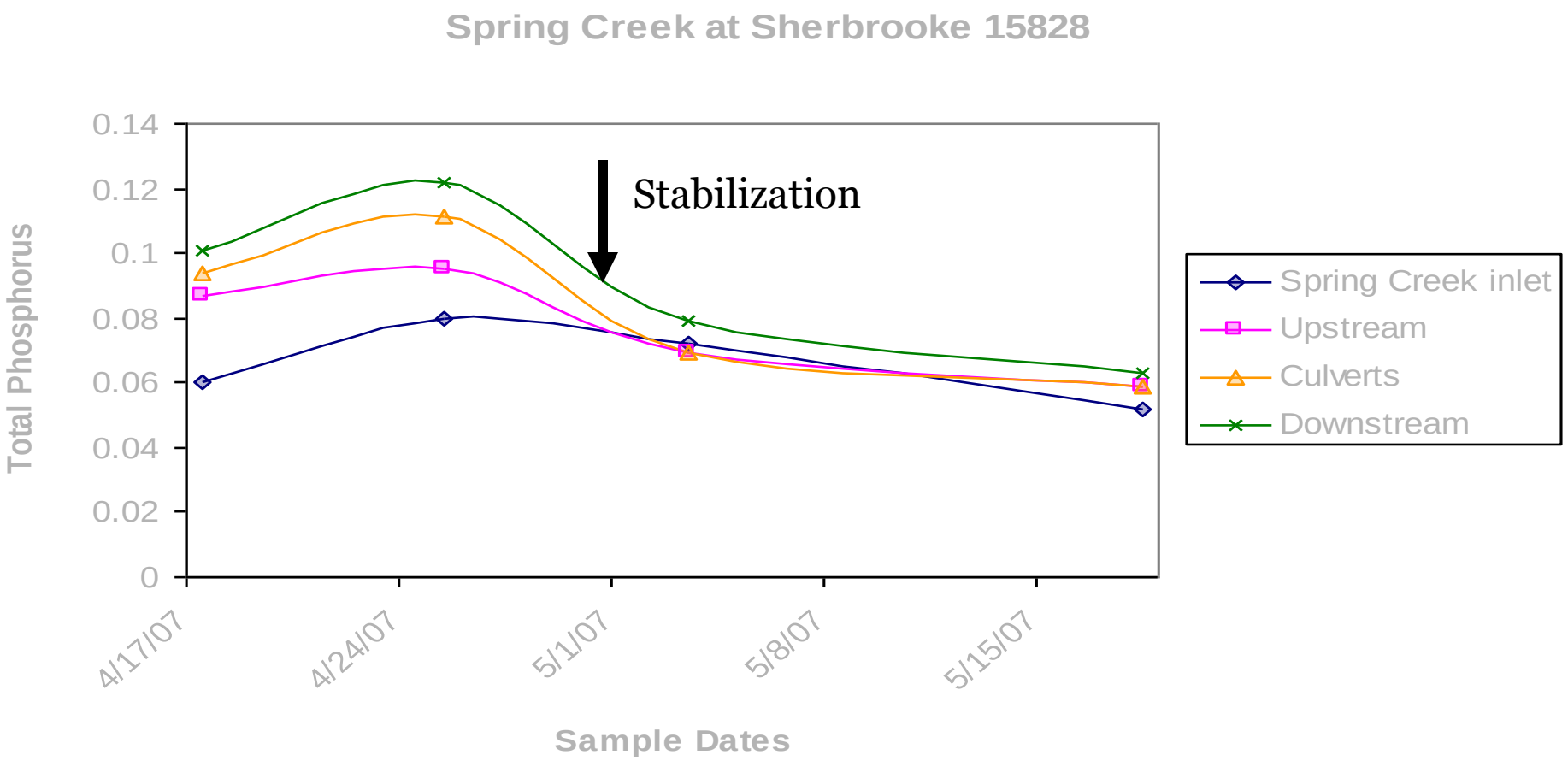
- Stabilization

Monitoring

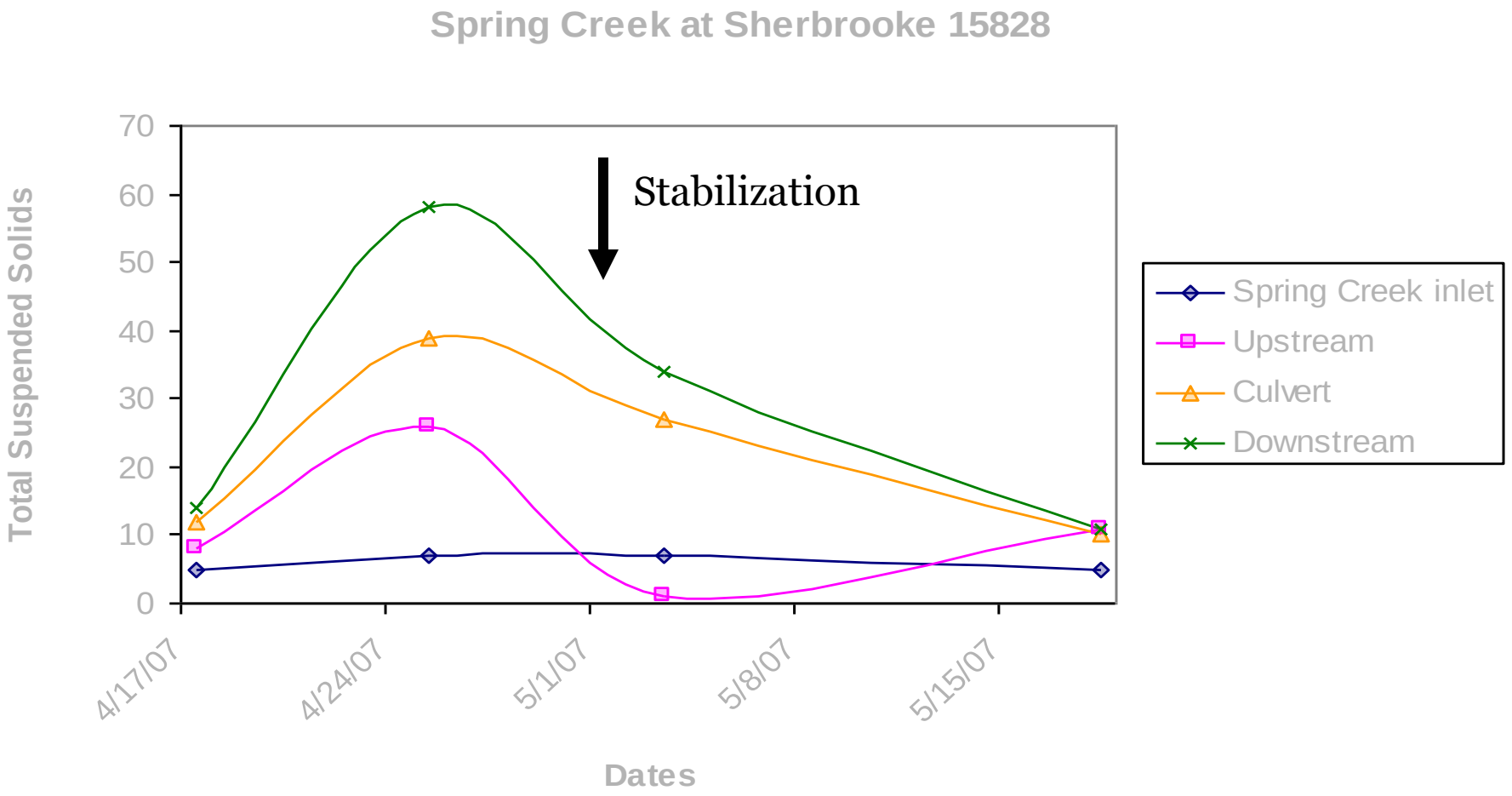
- Upstream
- Impact
- Downstream



Monitoring Data



Monitoring Data



Project Conclusions

- Once the erosion area was contained, the water quality improved
- Having baseline pre-project data and post project data was helpful for comparison

Worksheet

Worksheet #1

Could you calculate a trend from the following lake data?

Year	Annual Mean, Secchi (ft)
1999	12.0
2000	13.2
2004	11.8
2005	13.8
2006	14.1
2007	13.5
2008	12.7
2009	12.2
2010	13.7
2011	14.0
2012	11.9

Worksheet #2

Could you calculate a trend from the following lake data?

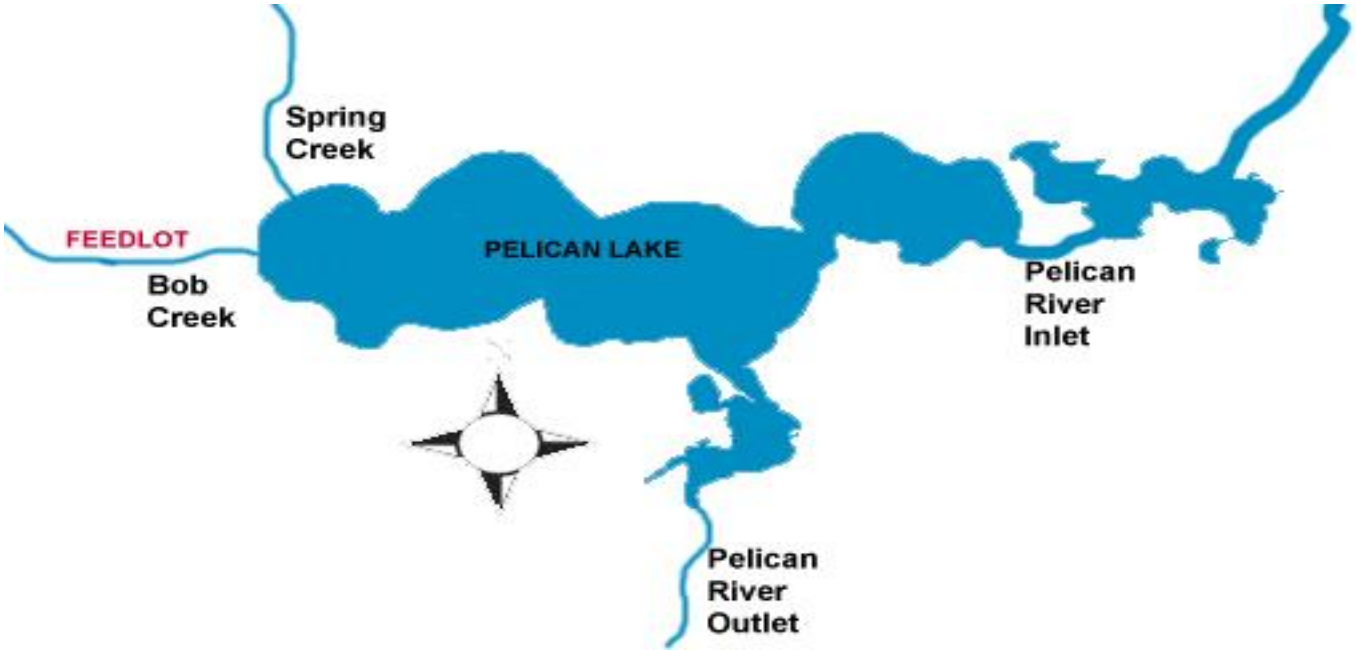
Year	Annual Mean, Secchi (ft)	#data points
2004	11.8	3
2005	13.8	2
2006	14.1	2
2007	13.5	3
2008	12.7	20
2009	12.2	20
2010	13.7	20
2011	14.0	20
2012	11.9	20

Worksheet #3

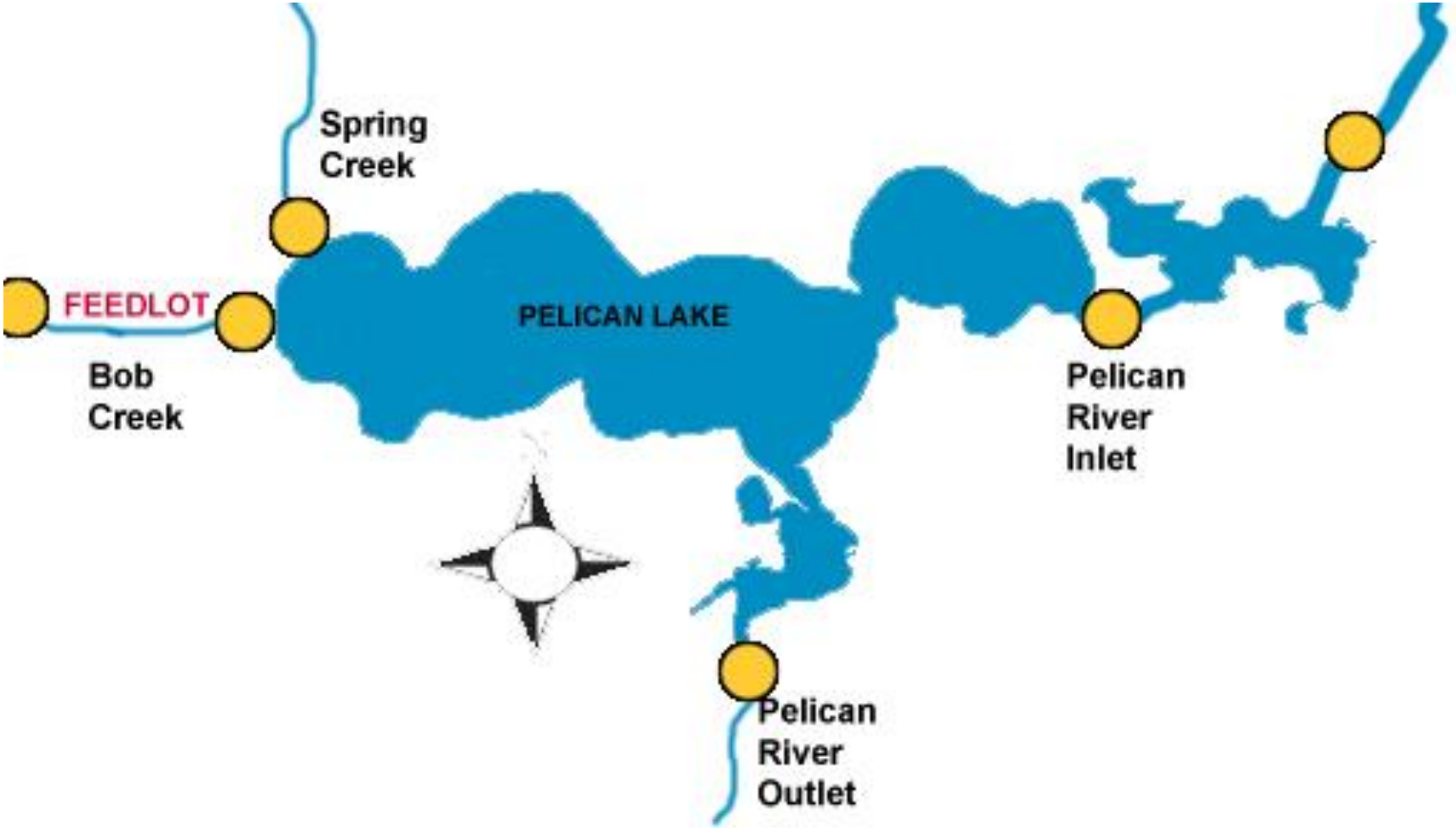
- The citizens in a lake association are upset because there is a cattle feedlot along one of the inlets to the lake, Bob Creek. They are worried that the feedlot is adding excess nutrients to the lake.

Worksheet #3

- How would you set up this monitoring program to answer the question of whether the feedlot is impacting the lake or not?



Monitoring Sites



Impact

- The following stream inlets were tested to lake

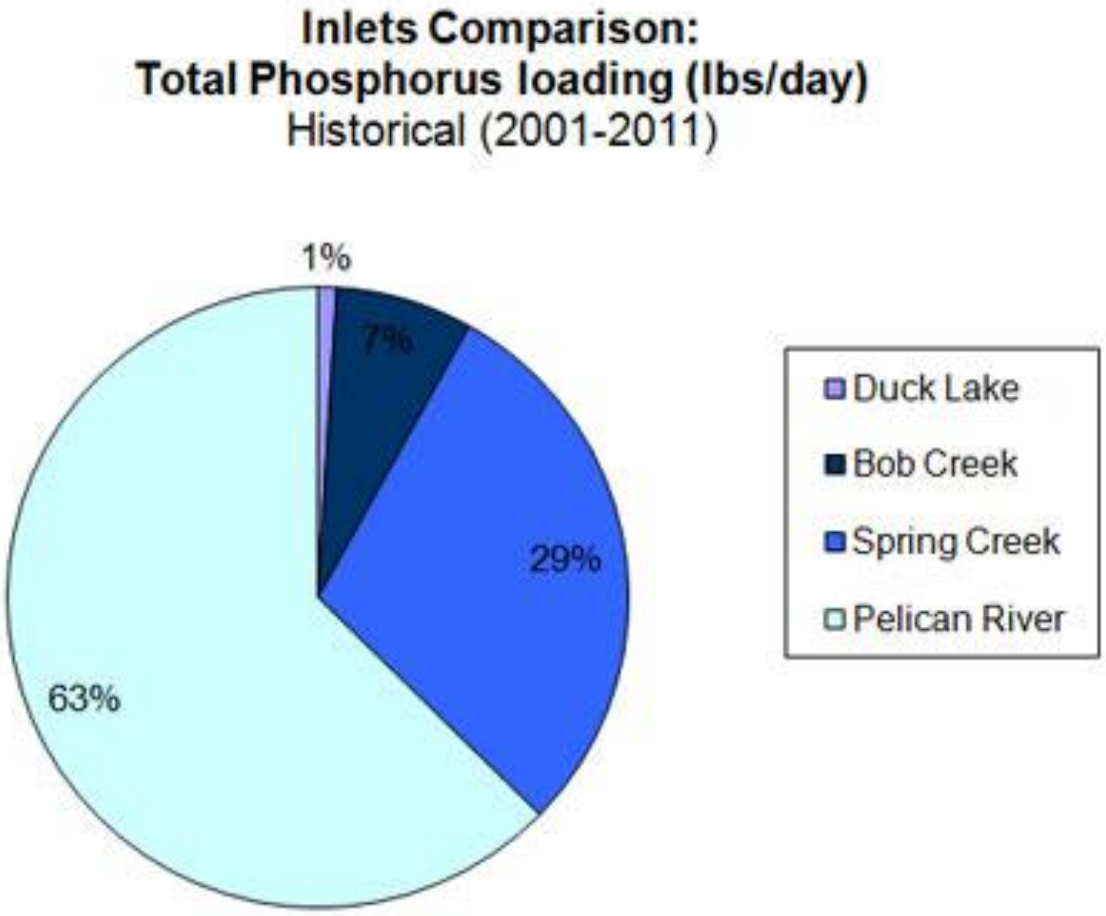
Site	Mean TP concentration (ug/L)
Bob Creek Downstream	50
Bob Creek Upstream	48
Spring Creek	86
Pelican River	18

Impact

- The following stream inlets were tested to lake

Site	Mean TP concentration (ug/L)	TP loading (lbs/day)
Bob Creek Downstream	50	0.93
Bob Creek Upstream	48	0.77
Spring Creek	86	4.34
Pelican River	**18**	**9.58**

Impact


Inlets Comparison:
Total Phosphorus loading (lbs/day)
Historical (2001-2011)
1%
7%
29%
63%
Duck Lake
Bob Creek
Spring Creek
Pelican River

Impact

- Not only was the feedlot not impacting the lake, it wasn't contributing the most nutrients to the lake.

Overall Conclusions

- Spend time developing your monitoring goals and plan first
- Choose sites and sampling frequency
- Only collect data you'll use
- Analyze your data during your monitoring program

Questions?